DESCRIPTION

Translation Method and Translation Apparatus

Technical Field

The present invention relates to a translation method and a translation apparatus for translating a source language entered, to a target language.

Background Art

Recently, a translation system for translating a language into another language has been implemented in practice. In this translation system, various studies have been made to improve a translation accuracy and a translation quality.

A so-called syntax-transfer type translation system performs a translation by paying attention to a syntactic correspondence between a source sentence and a target sentence and using a plenty of rules described by man power.

However, in this syntax-transfer type translation system, a detailed description of partial correspondence in syntax does not always improve the translation accuracy of the entire source sentence. Moreover, in the syntax-transfer type translation system, it is difficult to obtain a natural translated sentence because a target sentence is generated by using information items selected by a partial correspondence in syntax instead of the syntactic correspondence considering the entire source sentence.

Moreover, a so-called knowledge-based translation system performs translation by explicitly expressing the meaning of a source sentence, organizing knowledge of a comparatively limited related field as a conceptual system, and performing inference using this conceptual system. This knowledge-based translation system eliminates ambiguity in analysis and generation by using the conceptual system for inference and realizes a high-quality translation.

However, in the knowledge-based translation system, as the system size increases, it becomes difficult to maintain a consistency of the conceptual system. Moreover, in the knowledge-based translation system, since the meaning of the source sentence is explicitly described, the translation requires an enormous time and effort.

Furthermore, in a so-called example-based translation system, an enormous corpus is collected to be used so as to improve the translation accuracy and is considered to be capable of generating a natural target sentence as compared to the other translation systems.

However, in this example-based translation system, in general, a thesaurus is used to determine a distance in a conceptual space so as to decide a similarity with an example and a syntax analysis is performed to decide a syntactic similarity. Thus, the decision base is uniquely defined in the entire system. Accordingly, in the example-based translation system, when the corpus is not sufficient, the translation accuracy is significantly lowered. Consequently, the example-based translation system can be used for a particular use such as analysis of a complex phrase but a preparation

of the corpus requires an enormous time and effort, which disables to construct a practical system.

Furthermore, for example, Japanese Patent Publication 5-290082 and Japanese Patent Publication 10-11447 disclose a translation technique in which at translation knowledge of a translation example is described as a pattern and when a source sentence entered cannot be constructed as a combination of these patterns, a translation is performed by utilizing a set of patterns having a lower constriction or the aforementioned syntax-transfer type translation is performed. Thus, this method, while enabling maintenance of the entire translation system, enables to obtain a natural target sentence only for particular expressions.

However, in this method, when a source sentence cannot be constructed as a combination of patterns, the translation accuracy is lowered. Moreover, since a source sentence may be analyzed in a plurality of meanings because of the context or the user intention, in this method, even when the source sentence is matched with a combination of patterns, a target sentence may not match with the user intention.

In these conventional translation systems, there is a presupposition that any source sentence entered is automatically translated into a target sentence for output. The aforementioned problems associated with the conventional translation systems are caused by the fact that a study has been made to improve a translation accuracy and quality under the aforementioned presupposition.

In the conventional translation systems, the translation accuracy is gradually

improved by organizing the language data. However, there is no translation system which can be used by a user who has no knowledge of the target language. And a target sentence generated cannot be used practically.

Disclosure of the Invention

The present invention solves the problems in the conventional translation system which presupposes to automatically translate any source sentence entered, into a target sentence for output and has an object to provide a translation method and a translation apparatus enabling to obtain a highly-accurate and a high-quality translation result according to a user intention which has been considered to be impossible.

In order to achieve the aforementioned object, the translation method according to the present invention uses a translation information corresponding a source language sentence or part of a sentence and a target language sentence or part of a sentence, and decides a coincidence or similarity between the source language sentence or part of a sentence and a sentence constructed by a combination of translation information items, so that the source language sentence or part of a sentence is translated into a target language sentence or part of a sentence for output. The translation information includes descriptions of a source language sentence or part of a sentence, a corresponding target language sentence or part of a sentence, and a related information related to the source language sentence or part of a sentence and the target language sentence or part of a sentence.

The translation method according to the present invention uses a translation information containing descriptions of a source language sentence or part of a sentence and a target language sentence or part of a sentence as well as a related information related to the source language sentence or part of a sentence and the target language sentence or part of a sentence, so that the source language sentence or part of a sentence is translated into a target language sentence or part of a sentence.

Moreover, the translation apparatus according to the present invention, in order to achieve the aforementioned object, includes: input means for entering a source language sentence or part of a sentence; storage means for storing a translation information having descriptions of a source language sentence or part of a sentence and a corresponding target language sentence of part of a sentence as well as a related information related to the source language sentence or part of a sentence and the target language sentence or part of a sentence; analysis means which according to the translation information, decides a coincidence or similarity between the source language sentence or part of a sentence and a sentence constructed by a combination of the translation information items, so as to analyze the source language sentence or part of a sentence and generate a translation result candidate; target language sentence generating means for generating a target language sentence or part of a sentence as a translation result of the source language sentence or part of a sentence; and output means for outputting the target language sentence or part of a sentence generated by the target language sentence generating means.

Thus, the translation apparatus according to the present invention stores in the storage means a translation information having descriptions of a source language sentence or part of a sentence, a corresponding target language sentence or part of a sentence, and a related information related to the source language sentence or part of a sentence and the target language sentence or part of a sentence and by using this translation information, translates a source language sentence or part of a sentence into a target language sentence or part of a sentence.

Brief Description of the Drawings

Fig. 1 is a block diagram explaining a configuration of a translation apparatus as an embodiment of the present invention.

Fig. 2 explains an example of a translation information having a description of a link information and held in the translation apparatus.

Fig. 3 explains an example of a translation information having a description of a field information and a field limit information and held in the translation apparatus.

Fig. 4 is a block diagram showing a configuration of a bi-directional translation apparatus constructed by combining the translation apparatuses.

Fig. 5 explains an example of a translation information having a description of a response prediction information and held in the bi-directional translation apparatus.

Fig. 6 is a plan view of an external view of a voice translator as a specific example of the bi-directional translation apparatus.

Fig. 7 is a block diagram explaining a configuration of the voice translator.

Fig. 8 is a flowchart explaining a sequence of processes in the voice translator.

Fig. 9 is a flowchart explaining a sequence of processes in the voice translator performed after the processes shown in fig. 8.

Fig. 10 explains an example of a translation information held in the voice translator.

Fig. 11 explains an example of a translation information held in the voice translator.

Fig. 12 explains an example of a user check information generated in the voice translator and displayed on a liquid crystal block.

Fig. 13 explains another example of a user check information generated in the voice translator and displayed on a liquid crystal block and output through a loud speaker.

Fig. 14 explains an example of a target language sentence and a response prediction information generated in the voice translator and output through the liquid crystal block and the loud speaker.

Fig. 15 explains another example of a target language sentence and a response prediction information generated in the voice translator and output through the liquid crystal block and the loud speaker.

Best Modes for Carrying Out the Invention

Description will now be directed to embodiments of the present invention with reference to the attached drawings.

In a translation apparatus 10 according to the embodiment of the present invention, like in the so-called example-based translation, pattern-based translation, and template-based translation, a correspondence between a source language sentence or part of a sentence and a corresponding target language sentence or part of a sentence is used as a part of a basic information (translation information) and an information related to the source language sentence is described in this translation information, so as to decide a coincidence or similarity with a sentence constructed by a combination of the translation information items for performing a translation.

It should be noted that the translation apparatus 10 can translate not only a source language sentence but also a phrase or word constituting a sentence. Accordingly, in the explanation below, a sentence, phrase, word to be translated will be referred to as a sentence in general. That is, a source language sentence represents a sentence, phrase, or word of a source language and a target language sentence represents a sentence, phrase, or word of a target language.

As shown in Fig. 1, the translation apparatus 10 includes: an input block 11 as input means for entering a source language sentence in voice or characters and converting it into an analyzable data; a sentence analyzing block 12 as analyzing means for deciding a coincidence or similarity between a source language sentence and a sentence constructed by a combination of translation information items in a

translation information database 18 which will be detailed later; an application constraint decision block 13 as application constraint decision means for deciding whether a translation result candidate for a source language sentence satisfies an application constraint assigned to the translation information; a user check information generation block 14 for generating a check information to be represented to a user; a user check block 15 for representing the check information generated by the user check information generation block 14, to the user; a target language sentence generation block 16 as target language generating means for generating a target language sentence; a translation result output block 17 as output means for outputting in voice or characters the target language sentence generated by the target language sentence generation block 16; and a translation information database 18 for storing various translation information items.

In the translation apparatus 10, firstly, a source language entered is converted into a digital data by the input block 11. The source language sentence as the digital data is transmitted to the sentence analyzing block 12, which decides a coincidence or a similarity between the source language entered and a sentence constructed by a combination of translation information items in the translation information database 18. Thus, the translation apparatus 10 generates an expression near to the syntax of the source language sentence not depending on the context of the source language sentence or the user intention.

Next, in the translation apparatus 10, the application constraint decision block

13 decides whether each of the candidates generated satisfies all of the application constraints assigned for each of the translation information items. That is, the translation apparatus 10 does not use a uniquely defined decision reference indicating an applicability of each translation information item but describes an application constraint for each of the translation information items. When the translation apparatus 10 recognizes that any of the candidates does not satisfy all of the application constraints, the translation apparatus 10 excludes the candidate (expression). Accordingly, the translation apparatus 10 can perform a highly-accurate translation without having an enormous corpus.

It should be noted that in the translation apparatus 10, this decision may be performed by the sentence analyzing block 12. Moreover, in the translation apparatus 10, like in the example-based translation system, it is possible to use as a decision reference a distance in a conceptual space using a thesaurus. In this case, however, the decision accuracy of the coincidence or similarity between a source language sentence entered and a sentence constructed by a combination of translation information items is slightly lowered.

Furthermore, when the translation apparatus 10 recognizes that no candidate exists at this stage, the translation apparatus 10 reports to the user in characters or voice that the source language sentence cannot be translated and requests the user to enter another expression of the source language. Thus, the translation apparatus 10 does not translate all of the source sentences entered but rejects some of source

language sentences when they cannot be handled.

Next, according to an information assigned to the respective translation information constituting the respective candidates selected, the user check information generation block 14 generates an information to be represented to the user and represented by the user check block 15. The user selects a candidate which satisfies the context and intention. That is, in the translation apparatus 10, when a source language sentence is ambiguous due to the context or user intention and a plurality of target language sentences can be generated, an information required for user check is generated so that a final decision can be made by the user.

Here, the "information required for user check" is a user check source language sentence which is a source language sentence modified so as to match with the meaning of a corresponding target language sentence, or state explaining sentence explaining a condition when the user check source language sentence is used, or a state explaining image associated with a condition when the expression is used, or a state explaining voice associated with the condition when the expression is used.

That is, the user check source language sentence is a source language sentence which has been entered and modified according to a corresponding target language sentence depending on the context or user intention, i.e., the target sentence expressed in the source language. Moreover, the state explaining sentence is a sentence other than the source language sentence and explaining a state possible from the context or the user intention. Furthermore, the state explaining image and the state explaining

voice are an image and voice associated with the context or the user intention and expresses the content of the target language sentence. It should be noted that the image may be a still image or a moving image.

Upon user check, the translation apparatus 10 uses a user check source language sentence instead of a source language sentence and can generate a translation result accurately reflecting the context or the user intention. Moreover, upon user check, the translation apparatus 10 can use a state explaining sentence, a state explaining image, or a state explaining voice together with a source language sentence, so as to generate a translation result reflecting the context or the user intention. It should be noted that when a source language sentence entered is identical to a user check source language sentence to be described in the translation information, then the translation apparatus 10 omits the description of the user check source language sentence in the translation information.

Thus, in the translation apparatus 10, when a plurality of target language sentences can be generated as candidates for a source language sentence entered, the user is requested to select the most appropriate candidate and according to the selection, the meaning of the target language sentence is decided. Thus, even when the user enters a source language sentence without recognizing that the source language sentence is ambiguous, in case of the source language sentence is ambiguous, the user is requested to select the most appropriate candidate among the candidates represented by the translation apparatus 10. Thus, the translation apparatus 10 can

generate a correct translation result even if the meaning of the source language sentence cannot be determined by inference. This improves the translation accuracy.

After the check and selection by the user, the target language generation block 16 generates a target language sentence according to the translation information associated with the candidate selected by the user and outputs the target language sentence through the translation result output block 17, thus terminating a sequence of translation processes.

By performing the sequence of the processes, the translation apparatus 10 can perform a translation independently for each of the source language sentences entered.

Moreover, the translation apparatus 10 can modify the contents of the translation information so that a translation of a source language sentence affects the translation of a next source language sentence entered.

That is, a source language sentence entered next to another source language sentence may be associated with the same topic. In order to utilize this characteristic in the translation apparatus 10, as shown in Fig. 2 and Fig. 3, an information is added to the translation information so as to limit a next source language sentence to be entered.

Here, the "information to limit a next source language sentence to be entered" represents a link information to a translation information, a field information, and a field limit information.

That is, the link information in Fig. 2 is provided to limit the number of

translation information items to be handled for analyzing the next source language sentence to be entered and is a related information to be related to the translation information to be used for the next source language sentence to be entered. In the translation apparatus 10, a plurality of link information items may be described for a translation information. It should be noted that in the translation apparatus 10, when this link information is used, a common information flag is described to indicate a translation information used always regardless of a source language sentence to be entered after any source language sentence.

More specifically, as shown in Fig. 2, if it is assumed that link information a, b, and n contained in a translation information A are linked to translation information B, C, and N, respectively, when the translation information A is used for analyzing a source language sentence entered, the translation apparatus 10 needs to use only the link destinations of the link information a, b, ..., n, i.e., the translation information B, C, ..., N when analyzing the next source language sentence entered.

On the other hand, the field information and the field limit information shown in Fig. 3 are information items used for limiting a field to be handled when analyzing a next source language sentence entered. The field information contains an information indicating a field where the translation information is used. Moreover, the field limit information contains an information indicating a field to which the translation information to be used for translation of a source language sentence using the translation information belongs. In the translation apparatus 10, a plurality of field

information items and field limit information items may be described for a translation information.

In the translation apparatus 10, by using the link information, field information, and field limit information, it is possible to limit a candidate generated for a second source language sentence and after when translating a comparatively typical conversation such as a traveler's conversation, thus reducing the load for user in selecting a candidate.

It is possible to combine two of the aforementioned translation apparatuses 10 to constitute a bi-directional translation apparatus. That is, as shown in Fig. 4, a bi-directional translation apparatus 20 is constructed by combining a translation apparatus 10a having an identical configuration as the translation apparatus 10 for translating a source language sentence of a language A entered, into a target language sentence of a language B, and a translation apparatus 10b having an identical configuration as the translation apparatus 10 for translating a source language sentence of language B entered, into a target language sentence of language A.

In this bi-directional translation apparatus 20, a user enters a source language sentence and in response to its translation result, another user may enter a source language sentence. In the bi-directional translation apparatus 20, a translation information of one direction translation contains an information limiting a sentence to be entered by a conversation mate, i.e., an information for correlating to a translation information of the other direction translation.

In the bi-directional translation apparatus 20, each of the translation information in the translation information databases 18a and 18b contain descriptions of a link information to a translation information in the bi-directional translation as well as a field information and a field limit information in the bi-directional translation.

That is, the link information is provided in order to limit the number of translation information items to be used for a response from the translation apparatus 10b to a source language sentence entered to the translation apparatus 10a. A translation information item may contain descriptions of a plurality of link information items.

Here, for a specific explanation, it is assumed that the link information a, b, and c in a translation information in the translation apparatus 10a are linked to different information items in the translation apparatus 10b and that link information a, b, and c in a translation information in the translation apparatus 10b are linked to different translation information in the translation apparatus 10a. After a source language sentence of language A entered to the translation apparatus 10a is analyzed by using a translation information contained in the translation information database 18a, the bi-directional translation apparatus 20 analyzes the next source language sentence of language B entered to the translation apparatus 10b by using only the translation information in the translation information database 18b indicated as the link destinations of the link information a, b, and c in the translation information contained in the translation information database 18a. Moreover, when a translation information

contained in the translation information database 18b is used for analyzing a source language sentence entered as a response to the translation apparatus 10b, the bi-directional translation apparatus 20 can analyze a next source language sentence entered to the translation apparatus 10a, by using only the translation information in the translation information database 18a indicated as link destinations of the link information a, b, and c in the translation information in the translation information database 18b.

On the other hand, the field information and the field limit information are provided in order to limit the field to be handled for analyzing a source language sentence entered to the translation apparatus 10b in response to a source language sentence entered to the translation apparatus 10a. In the bi-directional translation apparatus 20, a plurality of these information items can be described in a translation information in each of the translation apparatuses 10a and 10b.

In the bi-directional translation apparatus 20, by using the link information and the field information and the field limit information, when translation a comparatively typical conversation such as a traveler's conversation, it is possible to limit the translation information to be used and limit the candidates generated by the translation of a source language sentence entered to the translation apparatus 10a or 10b, thus enabling to obtain a highly-accurate and high-quality translation.

Moreover, the bi-directional translation apparatus 20 can also be used as a conversation support translator for supporting a conversation by real-time translation.

In this case, as shown in Fig. 5 for example, the bi-directional translation apparatus 20 describes in the translation information a predicted example in response to a source language sentence entered to the translation apparatus 10a, as a response prediction information such as a response sentence, a response image, a response voice, and the like. The bi-directional translation apparatus 20 shows the user of the translation apparatus 10a an example as a possible response by the conversation mate of the translation apparatus 10b together with a translation result. It should be noted that the response image maybe a still image or a moving image.

Thus, the bi-directional translation apparatus 20 enables the users to perform a smooth conversation.

Explanation has been given on the translation apparatus 10 according to an embodiment of the present invention and the bi-directional translation apparatus 20 as an applied example of the translation apparatus 10. Description will now be directed to a conversation-support type voice translator 30 having an outer view as shown in Fig. 6.

As shown in Fig. 6, the voice translator 30 is to be used by a user and his/her conversation mate standing or sitting face to face sandwiching the voice translator 30. The voice translator 30 includes as portions shared by a user and his/her conversation mate a liquid crystal block 31 for displaying an information required for conversation such as a translation result in characters or image in the direction to the user and the conversation mate; and a loud speaker 32 for outputting an information required for

conversation; and includes as portions dedicated to the user and the conversation mate direction buttons 33a and 33b for various operations, selection buttons 34a and 34b for selecting OK/CANCEL, voice input buttons 35a and 35b to be pressed when the user and the conversation mate enter a voice, and microphones 36a and 36b for entering a voice from the user and the conversation mate.

As shown in Fig. 7, the voice translator 30 includes: a voice input block 41a as input means through which a source language sentence in voice from the microphone 36a of the user side is entered and converted into a digital data; a voice recognition block 42a as voice recognition means for performing a successive word recognition of the source language sentence as the digital data according to an acoustic processing and a statistical language model; a sentence analyzing block 43a for as analyzing means for analyzing an output from the voice recognition block 42a; an application constraint decision block 44a as application constraint decision means for deciding whether a candidate as a translation result of the source language sentence satisfies the application constraint assigned for the translation information held in the translation information database 49a which will be detailed later; a user check information generation block 45a for generating a check information to be represented to the user; a user check block 46a for outputting the check information to the liquid crystal block 31 and the loud speaker 32; a target language sentence generation block 47a as target language generation means for generating a target language sentence; a translation result output block 48a as output means for outputting the target language sentence

generated by the target language sentence generation block 47a, to the liquid crystal block 31 and the loud speaker 32; a translation information database 49a as storage means for holding various translation information items; a voice recognition object limit block 50a as voice recognition object limit means for holding a limit condition to be applied to the output from the voice recognition block 42a; a translation information selection block 51a for holding a translation information selection condition to be used for the source language sentence entered; a response prediction block 52a as response prediction means for generating a response prediction information; and a response prediction representation block 53a as response prediction representation means for outputting the response prediction information generated by the response prediction block 52a.

Moreover, the voice translator 30 also includes for the conversation mate like in the user side: a voice input block 41b as second input means; a voice recognition block 42b; a sentence analyzing block 43b as second analyzing means; an application constraint decision block 44b; a user check information generation block 45b; a user check block 46b; a target language generation block 47b as second target language sentence generation means; a translation result output block 48b as second output means; a translation information database 49b as second storage means; a voice recognition object limit block 50b; a translation information selection block 51b; a response prediction block 52b; and a response prediction representation block 53b.

The voice translator 30 performs a sequence of processes as shown in Fig. 8 and

Fig. 9 for bi-directional translation to support a conversation between a user and a conversation mate. Here, an explanation will be given on a case when a user enters a source language sentence of Japanese to be translated into a target language sentence of English.

Firstly, as shown in Fig. 8, in step S1, a source language sentence uttered and entered by the user toward the microphone 36a while pressing the voice input button 35a is converted into a digital data by the voice input block 41a.

Next, the source language sentence which has been converted into the digital data is subjected, in step S2, to a successive word recognition according to an acoustic processing and a statistical language model by the voice recognition block 42a. The successive word recognition may employ the HMM-based recognition technique used widely or other methods. The voice translator 30 generates a word graph by this successive word recognition.

In step S3, the voice translator 30 decides whether the voice recognition object limit block 50a contains a limit condition to be applied to the word graph generated. This limit condition is an information to limit a range to be handled by the voice recognition block 42a so as to increase the accuracy of the voice recognition and represents an information to limit a next source language sentence entered by the user and an information to limit a next source language sentence entered by the conversation mate. This limit condition may be, for example, a field information of the source language sentence described in the translation information. Here, the limit

condition is assumed to be a set of related independent words generated from the translation information associated with the translation information used for processing the preceding source language sentence.

Here, when the voice translator 30 decides that no limit condition is held in the voice recognition object limit block 50a, control is passed to step S5. That is, when an initial source language sentence is entered, the voice recognition object limit block 50a has no limit condition and the voice translator 30 passes control to step S5.

On the other hand, when the voice translator 30 decides that the voice recognition object limit block 50a contains a limit condition, control is passed to step S4, where the limit condition is applied to the word graph generated, so as to reduce the size of the word graph to limit the recognition lexicon. That is, when the generated word graph contains a node containing an independent word not contained in the aforementioned set of independent words, that portion is deleted to reduce the entire size of the word graph.

Furthermore, in step S5, the voice translator 30 decides whether the size of the word graph exceeds a predetermined size.

Unless the word graph size exceeds the predetermined size, the voice translator 30 passes control to step S7.

On the other hand, when the word graph size is too large even after the processing of step S4, the voice translator 30 passes control to step S6, where a marking by a so-called N-Best search is performed, and a node associated with the one

having a high probability of appearance is left, and a node not contained in the path is deleted, thus reducing the word graph size, so that the word graph size does not exceed the predetermined size.

Next, in steps S7 to S9, the voice translator 30 causes the sentence analysis block 43a to analyze the word graph output from the voice recognition block 42a and the application constraint decision block 44a to perform an application constraint decision. These processes will be detailed with reference to the translation information shown in Fig. 10 and Fig. 11.

The voice translator 30 has the translation information as shown in Fig. 10 in the translation information database 49a. It should be noted that among the translation information items, information other than the source language sentence and the target language sentence is an information described according to the necessity and not all of the items are described for all the translation information entries.

The voice translator 30 is basically an example-based translation system and performs a translation by deciding a similarity between a source language sentence and a sentence constructed by a combination of translation information items. In order to obtain an accurate translation without using a number of examples, the two modifications are performed with respect to the general similarity decision as follows.

Firstly, as the first modification, the voice translator 30 decides a similarity associated with the sentence structure. That is, an ordinary example-based translation system performs a syntax analysis and according to the result, performs a similarity

decision while the voice translator 30 performs a correct similarity decision by describing in the translation information a grammatical category such as parts of speech allowed for the respective examples. Moreover, as the second modification, the voice translator 30 performs a similarity decision associated with the word meaning. That is, an ordinary example-based translation system defines a distance between words in a conceptual space using a thesaurus and performs a similarity decision by checking whether the distance is not greater than a predetermined value while the voice translator 30 performs a correct similarity decision by describing a lexical category including a maximum number of words in an allowed range.

By adding these modifications, the voice translator 30 evades an accuracy lowering by describing a further information for a portion in the translation information which may lower the accuracy. Moreover, the voice translator 30 considers the description of a grammatical category as a non-terminal symbol, so that the respective translation information items are handled as context free grammar rules.

Fig. 11 shows specific examples of the translation information in the voice translator 30. The items in Fig. 11 represent meanings shown in Table 1 below.

Table 1

Explanation of items in the translation information

SRC:	source language sentence
SRCCOND:	application constraint (source language)

TGT:	target language sentence
TGTCOND:	application constraint (target language sentence)
UISRC:	user check source language sentence
STATUSMSG:	status explaining sentence
STATUSVICEO:	status explaining image
STATUSAUIDO:	status explaining voice
LINKNEXT:	related information to the next sentence
LINKRESP:	related information to the next response sentence
RESPSRC:	response sentence (source language)
RESPTGT:	response sentence (target language)
RESPVIDEO:	response image
RESPAUDIO:	response voice

As shown in Fig. 11, in the voice translator 30, for example, the terms used in the translation information such as ":S@1" and "densya:NP::vehicle@1" in the right side and the left side are <script> : <grammatical category> : <feature> : <lexical category> @ <link number>. Unnecessary terms and delimiters can be omitted.

Here, the <grammatical category> corresponds to the aforementioned first modification and the <lexical category> corresponds to the second modification.

The <link number> indicates the number of link information associated with the portion described in each sentence. When an identical number is attached in different

sentences, they are associated with the same link information.

Moreover, the <feature> is used for describing a conjugation of a verb or auxiliary verb and its limit.

The numbers described in the <LINKNEXT> and <LINKRESP> are translation information numbers, each indicating the one described in the line starting with "#". That is, the translation information number is a file name which guarantees that the translation information is uniquely defined. This translation information number may make difficult a maintenance of the translation information. However, the voice translator 30 uses a separate translation information authoring system and these information items can be described without using a man power.

In the voice translator 30, according to the translation information selection condition, which will be detailed later, held in the translation information selection block 51a, only the source language sentence in the translation information selected in step S7 of Fig. 8 is used by the sentence analysis block 43a to decide which combination of the translation information items can constitute the source language sentence entered. For example, the voice translator 30 considers the source language sentence in the translation information as a context free grammar rule and performs an analysis by a so-called chart parser using a word graph as an input.

It should be noted that the chart parser is a technique generally used as a syntactic analysis method as is explained in Tanaka Hozumi "Shizen gengo kaiseki no kiso (Introduction to analysis of the natural language)", Sangyo tosyo, 1989. Here, its

explanation is omitted.

By performing an analysis by this chart parser, in step S8, the voice translator 30 generates a plurality of sentence candidates constructed as combinations of the translation information items from the word graph as the voice recognition result.

When there are more than one sentences constructed by identical combination of the translation information items, then in step S9, only the optimal candidate is selected, excluding the others according to the similarity counting like in the ordinary example-based translation system and when the translation information contains a description of an application constraint, then the application constraint decision block 44a performs an application constraint decision and deletes a candidate not satisfying the condition.

By these processes, the voice translator 30 generates an optimal candidate for the source language sentence.

More specifically, in case the voice translator 30 holds the translation information shown in Fig. 11, and for example, the user enters "Futakotamagawaen keiyu no densya ha donokurai kakaru ka" of which the voice recognition is correctly performed, the sentence analysis block 43a generates as candidates "a sentence constructed by a combination of the translation information 120 and the translation information 283 for asking the time" and "a sentence constructed by a combination of the translation information 130 and the translation information 283 for asking the fare".

Next, as shown in Fig. 9, the voice translator 30, in step S10, decides whether a candidate exists.

Here, when no candidate exists, the voice translator 30 passes control to step S20, where it is represented to the user that no candidate exists in characters or image on the liquid crystal block 31 or a voice through the loud speaker 32, thus terminating the sequence of processes.

On the other hand, when a candidate exists, the voice translator 30 passes control to step S11, where according to the candidate generated, the user check information generation block 45a generates a user check information. That is, the voice translator 30 generates a user check source language sentence according to the user check source language sentence described in the translation information and the link information described there. In the voice translator 30, the user check source language may be described for each translation information or may not be described in each translation information. For example, in the voice translator 30, when a source language sentence entered is identical to a user check source language sentence to be described in the corresponding translation information, then description of the user check source language sentence into the translation information is omitted. When no description is contained in the translation information, the voice translator 30 uses the source language sentence instead.

More specifically, the voice translator 30 generates a user check source language sentence "Futakotamagawaen keiyu no densya ha donokurai zikan ga kakaru

ka" from the combination of the translation information 120 and the translation information 283 shown in Fig. 11 and generates a user check source language sentence "Futakotamagawaen keiyu no densya ha donokurai okane ga kakaru ka" from the combination of the translation information 130 and the translation information 283.

Moreover, the voice translator 30 can generate as a user check information, a status explaining sentence, a status explaining image, and a status explaining voice. The status explaining sentence, the status explaining image, and the status explaining voice explains the translation information independently of the source language sentence. Accordingly, when the status explaining sentence, the status explaining image, and the status explaining voice are described in the corresponding translation information, they are successively generated without performing unification such as a user check source language sentence.

Thus, according to each of the candidates generated, the voice translator 30 generates a user check information corresponding to the meaning of the candidate.

Subsequently, in step S12 of Fig. 9, the voice translator 30 displays the user check information generated, via the user check block 46a, on the liquid crystal block 31 and outputs it through the loud speaker 32 so as to be represented to the user.

In response to this, in step S13, the user selects the most appropriate candidate from the user check information according to the context of the source language sentence and the user intention.

More specifically, as shown in Fig. 12 for example, the voice translator 30

displays on the liquid crystal block 31 the user check source language sentence "Futakotamagawaen keiyu no densya ha donokurai zikan ga kakaru ka" generated by the combination of the translation information 120 and the translation information 283 and the user check source language sentence "Futakotamagawaen keiyu no densya ha donokurai okane ga kakaru ka" generated by the combination of the translation information 130 and the translation information 283 shown in Fig. 11. Moreover, as shown in Fig. 13 for example, the voice translator 30 displays on the liquid crystal block 31 a user check source language sentence "Sumimasen" generated from the translation information 457 shown in Fig. 11 for apology and a user check source language sentence "Sumimasen" generated from the translation information 458 shown in Fig. 11 for thanks and simultaneously with this, displays on the liquid crystal block 31 an image explaining the status and outputs a voice explaining the status through the loud speaker 32. According to these user check information outputs, the voice translator 30 enters a state for the user to operate the direction button 33a to select a candidate and press the selection button 34a to determine the selection.

Thus, the voice translator 30 uses the user check source language sentence, the status explaining sentence, the status explaining image, and the status explaining voice, so that the meaning of the target language sentence as the translation result is correctly understood by the user. Through the selection by the user, even an ambiguous source language sentence can be correctly translated.

After the selection by the user, in step S14 in Fig. 9, the voice translator 30

generates a target language sentence in the target language generation block 47a. Moreover, when the translation information contains a description of a response sentence, a response image, and a response voice, the voice translator 30, in step S15, generates the response sentence, the response image, and the response voice in the response prediction block 52a. When the response sentence (source language, target language) in the translation information has a description of a link information, the voice translator 30, in the same way as the user check source language sentence, generates a response sentence according to the response sentence described in the translation information and the link information described there. Moreover, when no link information is described for the response sentence (source language, target language) in the translation information, the voice translator 30, in the same way as the status explaining sentence, generates a response sentence by combining sentences as they are without performing unification into one as a response sentence. Furthermore, in the same way as the status explaining image and the status explaining voice, the voice translator 30 generates a response image and a response voice by combining the response image and the response voice as they are.

More specifically, the voice translator 30 generates a target sentence "How long will the train which via Futakotamagawaen take?" for the source sentence "Futakotamagawaen keiyu no densya ha donokurai zikan ga kakaru ka" and a target sentence "How much will the train which runs via Futakotamagawaen cost?" for the source language sentence "Futakotamagawaen keiyu no densya ha donokurai okane ga

kakaru ka". Moreover, when a source language sentence "Sumimasen" for thanks is translated, the voice translator 30 references the translation information 458 shown in Fig. 11 and predicts and generates a response sentence "You are welcome" and generates "Douitashimashite" as its meaning.

It should be noted that in the voice translator 30, a plurality of response sentences, response images, and response voices may exist for each translation information, and accordingly, when generating these response prediction information items, it is necessary to handle all of the response sentences, response images, and response voices in each translation information.

Next, in step S16 in Fig. 9, the voice translator 30 sets a translation information selection condition. That is, according to a current translation result, the voice translator 30 performs a processing to limit a translation information to be used for a next source language sentence to be entered.

More specifically, like the translation information 120 in Fig. 11, when a number is described in <LINKNEXT>, the voice translator 30 records a related translation information in the translation information selection block 51a, so that a next source language sentence to be entered can be processed by using only the translation information thus described and a general-purpose translation information used under any condition. Thus, in the voice translator 30, the translation information selection condition for translating the next source language sentence to be entered is set and according to this translation information selection information, the range of the

translation information to be selected is limited. When the voice translator 30 cannot perform a processing correctly by using such a limit condition, these limit conditions are removed and the processing is performed again. Thus, the voice translator 30 has a flexibility even when the context is switched from one to another.

Similarly, when a number is described in <LINKRESP> like the translation information 120 shown in Fig. 11, in step S17 in Fig. 9, according to the information described in <LINKRESP>, the voice translator 30 sets a translation information selection condition in the reverse translation for translating a source language sentence entered by the conversation mate and records the condition in the translation information selection block 51a.

Furthermore, in step S18, according to this translation information selection condition, the voice translator 30 sets a limit condition for voice recognition and records the condition in the voice recognition object limit block 50a. In the voice translator 30, since the voice recognition block 42a cannot use the translation information directly, a list of independent words contained in a related translation information recorded in the voice recognition object limit block 50a is generated and held in the voice recognition object limit block 50a, so that this list of independent words is used as a limit condition for the voice recognition.

Next, in step S19, the voice translator 30 outputs the target language sentence and the response prediction information generated, via the translation result output block 48a and the response prediction presentation block 53a, respectively, thus

terminating the sequence of processes.

More specifically, as shown in Fig. 14 and Fig. 15 for example, the voice translator 30 displays the generated target sentence and the response prediction information in characters on the liquid crystal block 31 and outputs them in voice through the loud speaker 32.

After this sequence of processes, in the voice translator 30, the voice input button 35b or the voice input button 35a is pressed by the conversation mate or the user and a source language sentence is entered, so that the source language sentence is translated by repeating the aforementioned sequence of processes. It should be noted that in the voice translator 30, a processing identical to the aforementioned sequence of processes is performed when translating a source language sentence entered by the conversation mate.

As has been described above, each of the translation apparatus 10, the bi-directional translation apparatus 20, and the voice translator 30 explained as embodiments of the present invention is capable of performing a highly-accurate and high-quality translation satisfying the user intention which has been impossible in the conventional apparatuses and realizes a highly-accurate translation system. Especially, the voice translator 30 can support a smooth conversation and realizes a highly-accurate voice translation system which can easily be used.

It should be noted that the aforementioned configurations shown as the embodiments are only examples and the present invention is not to be limited to these

configurations. For example, the present invention can also be applied to a case when a source language sentence is entered in characters instead of voice.

Moreover, the embodiments have been explained as an example based on the example-based translation system but the present invention can employ a translation method such as the pattern-based translation and the template-based translation.

Furthermore, the present invention can be modified without departing from the spirit of the present invention.

Industrial Applicability

As has been explained above, the translation method according to the present invention uses a translation information showing a correspondence between a source language sentence or part of a sentence entered and a target language sentence or part of a sentence and determines a coincidence or similarity between the source language sentence or part of a sentence and a sentence constructed by combining translation information items, so that the source language sentence or part of a sentence is translated into a target language sentence or part of a sentence. The translation information has description of a source language sentence or part of a sentence, a corresponding target language sentence or part of a sentence, and a related information related to the source language sentence or part of a sentence and the target language sentence or part of a sentence.

Accordingly, the translation method according to the present invention uses a translation information having description of not only the source language sentence or

part of a sentence and the target language sentence or part of a sentence but also the related information related to the source language sentence or part of a sentence and the target language sentence or part of a sentence and enables to obtain a highly-accurate and high-quality translation result and support a smooth conversation as compared to a case when using a translation information containing only a source language sentence or part of a sentence and a target language sentence or part of a sentence.

Moreover, the translation apparatus according to the present invention includes: input means for entering a source language sentence or part of a sentence; storage means containing a description of a source language sentence or part of a sentence and a corresponding target language sentence or part of a sentence as well as a related information related to the source language sentence or part of a sentence and the target language sentence or part of a sentence; analysis means for deciding according to the translation information a coincidence or similarity between the source language sentence or part of a sentence and a sentence constructed by combining translation information items, thereby analyzing the source language sentence or part of a sentence and generating a translation result candidate; target language sentence generating means for generating a target language sentence or part of a sentence as a translation of the source language sentence or part of a sentence; and output means for outputting the target language sentence or part of a sentence generated by the target language sentence generating means.

Thus, the translation apparatus according to the present invention uses a translation information containing descriptions of not only a source language sentence or part of a sentence and a target language sentence or part of a sentence but also a related information related to the source language sentence or part of a sentence and the target language sentence or part of a sentence, thereby enabling to obtain a highly-accurate and high-quality translation result satisfying the context of the source language sentence or part of a sentence and the user intention and support a smooth conversation, as compared to a case when translation is performed by using a translation information containing only a source language sentence or part of a sentence and a target language sentence or part of a sentence.